OUTLET AIRFLOW DIRECTION CONTROL DEVICE

FIELD OF THE INVENTION

The present invention relates to an outlet airflow direction control device that includes a frame and a fan mounted to a hub seat provided in the frame, and a plurality of fluid control elements radially arranged between the frame and the hub seat to connect them to each other.

BACKGROUND OF THE INVENTION

Most currently developed electronic products are miniaturized while they have powerful functions and constantly increased working frequency and operating speed. The higher the working frequency is, the more heat is produced during the operation of the electronic products. The electronic products tend to become unstable when they operate under a high-temperature state. Therefore, it has become an important issue to effectively and quickly remove waste heat from the electronic products to reduce an internal temperature thereof. The use of a fan is one of many economical ways to effectively remove heat from the operating electronic products. When a motor of the fan is actuated to rotate blades of the fan, electric energy is converted into mechanical energy, which is transferred via the blades to cause flowing of a fluid and increasing a coefficient of convection in a limited space, so that flowing of fluid produced by changes in pressure and increase of speed is used to carry away extra heat produced by the electronic products during operation thereof and achieve the purpose of dissipating heat.

Generally, when an amount of fluid is driven by the rotating blades

of the fan to flow through an outlet of the fan, the fluid only diffuses into outer areas surrounding the fan. Since the fan is not able to control the flow direction of the fluid, a relatively large dead-air zone is formed behind a hub of the fan to largely reduce the radiation effect that may be achieved by the fan. When the conventional fan is mounted at a location having poor air ventilation and high impedance to dissipate heat produced by electronic elements, the dead-air zone behind the hub of the fan actually largely reduces the radiation effect that may be achieved by the fan, resulting in damaged electronic elements due to high temperature produced during working of the electronic elements.

Taiwanese Invention Patent Application No. 090118816 entitled "Sectional Fan and a Fan Frame Thereof" discloses a sectional fan that includes a fan and a fan frame. The fan frame further includes a first frame and a first flow-guiding element provided in the first frame. The first flow-guiding element includes a plurality of radially extended stationary blades. When the fan is rotated, the stationary blades are adapted to enhance the volume and pressure of airflow produced by the fan.

With the above-mentioned sectional fan, it is possible to produce an increased amount of fluid flown through the fan, however, it is unable to control the direction in which the fluid flown out of the rotating fan, just as in most cases of the conventional fans. Thus, there is still a relatively large dead-air zone behind the hub of the sectional fan to adversely affect the effective radiating of heat produced by the electronic products.

It is therefore tried by the inventor to develop an outlet airflow direction control device to eliminate drawbacks existed in the conventional radiating fans.

SUMMARY OF THE INVENTION

A primary object of the present invention is to provide an outlet airflow direction control device that uses fluid control elements to produce a relative large radial pressure against the fluid flown through the device, so as to affect the flow direction of the fluid at the outlet of the device.

BRIEF DESCRIPTION OF THE DRAWINGS

The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein

Fig. 1 is a rear exploded perspective view of an outlet airflow direction control device according to a first embodiment of the present invention;

Fig. 2 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 1;

Fig. 3 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 1;

Fig. 4 is a cross sectional view of the outlet airflow direction control device of Fig. 1 showing airflow directions at an outlet of the device;

Fig. 5 shows a variant of the directional-guide blade included in the first embodiment of the present invention;

Fig. 6 shows another variant of the directional-guide blade included in the first embodiment of the present invention;

Fig. 7 is a rear exploded perspective view of an outlet airflow direction control device according to a second embodiment of the present invention;

Fig. 8 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 7;

Fig. 9 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 7;

Fig. 10 is a cross sectional view of the outlet airflow direction control device of Fig. 7 showing airflow directions at an outlet of the device;

Fig. 11 is a rear exploded perspective view of an outlet airflow direction control device according to a third embodiment of the present invention;

Fig. 12 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 11;

Fig. 13 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 11;

Fig. 14 is a cross sectional view of the outlet airflow direction control device of Fig. 11 showing airflow directions at an outlet of the device;

Fig. 15 shows a variant of the directional-guide blade included in the third embodiment of the present invention;

Fig. 16 shows another variant of the directional-guide blade included in the third embodiment of the present invention;

Fig. 17 is a rear exploded perspective view of an outlet airflow direction control device according to a fourth embodiment of the present invention;

Fig. 18 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 17;

Fig. 19 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 17;

Fig. 20 is a cross sectional view of the outlet airflow direction control device of Fig. 17 showing airflow directions at an outlet of the device;

Fig. 21 is a rear exploded perspective view of an outlet airflow direction control device according to a fifth embodiment of the present invention;

Fig. 22 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 21;

Fig. 23 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 21;

Fig. 24 is a cross sectional view of the outlet airflow direction control device of Fig. 21 showing airflow directions at an outlet

of the device;

Fig. 25 shows a variant of the directional-guide blade included in the fifth embodiment of the present invention;

Fig. 26 shows another variant of the directional-guide blade included in the fifth embodiment of the present invention;

Fig. 27 is a rear exploded perspective view of an outlet airflow direction control device according to a sixth embodiment of the present invention;

Fig. 28 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 27;

Fig. 29 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 27;

Fig. 30 is a cross sectional view of the outlet airflow direction control device of Fig. 27 showing airflow directions at an outlet of the device;

Fig. 31 is a front exploded perspective view of an outlet airflow direction control device according to a seventh embodiment of the present invention;

Fig. 32 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 31;

Fig. 33 is a front assembled perspective view of the outlet airflow direction control device of Fig. 31;

Fig. 34 is a cross sectional view of the outlet airflow direction control device of Fig. 31 showing airflow directions at an outlet of the device;

Fig. 35 shows a variant of the directional-guide blade included in the seventh embodiment of the present invention;

Fig. 36 shows another variant of the directional-guide blade included in the seventh embodiment of the present invention;

Fig. 37 is a front exploded perspective view of an outlet airflow direction control device according to an eighth embodiment of the present invention;

Fig. 38 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 37;

Fig. 39 is a front assembled perspective view of the outlet airflow direction control device of Fig. 37;

Fig. 40 is a cross sectional view of the outlet airflow direction control device of Fig. 37 showing airflow directions at an outlet of the device;

Fig. 41 is a front exploded perspective view of an outlet airflow direction control device according to a ninth embodiment of the present invention;

Fig. 42 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 41;

Fig. 43 is a front assembled perspective view of the outlet airflow

direction control device of Fig. 41;

Fig. 44 is a cross sectional view of the outlet airflow direction control device of Fig. 41 showing airflow directions at an outlet of the device;

Fig. 45 shows a variant of the directional-guide blade included in the ninth embodiment of the present invention;

Fig. 46 shows another variant of the directional-guide blade included in the ninth embodiment of the present invention;

Fig. 47 is a front exploded perspective view of an outlet airflow direction control device according to a tenth embodiment of the present invention;

Fig. 48 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 47;

Fig. 49 is a front assembled perspective view of the outlet airflow direction control device of Fig. 47;

Fig. 50 is a cross sectional view of the outlet airflow direction control device of Fig. 47 showing airflow directions at an outlet of the device;

Fig. 51 is a front exploded perspective view of an outlet airflow direction control device according to an eleventh embodiment of the present invention;

Fig. 52 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 51;

Fig. 53 is a front assembled perspective view of the outlet airflow direction control device of Fig. 51;

Fig. 54 is a cross sectional view of the outlet airflow direction control device of Fig. 51 showing airflow directions at an outlet of the device;

Fig. 55 shows a variant of the directional-guide blade included in the eleventh embodiment of the present invention;

Fig. 56 shows another variant of the directional-guide blade included in the eleventh embodiment of the present invention;

Fig. 57 is a front exploded perspective view of an outlet airflow direction control device according to a twelfth embodiment of the present invention;

Fig. 58 is a rear exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 57;

Fig. 59 is a front assembled perspective view of the outlet airflow direction control device of Fig. 57;

Fig. 60 is a cross sectional view of the outlet airflow direction control device of Fig. 57 showing airflow directions at an outlet of the device;

Fig. 61 is a rear exploded perspective view of an outlet airflow direction control device according to a thirteenth embodiment of the present invention;

Fig. 62 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 61;

Fig. 63 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 61;

Fig. 64 is a cross sectional view of the outlet airflow direction control device of Fig. 61 showing airflow directions at an outlet of the device;

Fig. 65 shows a variant of the directional-guide blade included in the thirteenth embodiment of the present invention;

Fig. 66 shows another variant of the directional-guide blade included in the thirteenth embodiment of the present invention;

Fig. 67 is a rear exploded perspective view of an outlet airflow direction control device according to a fourteenth embodiment of the present invention;

Fig. 68 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 67;

Fig. 69 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 67;

Fig. 70 is a cross sectional view of the outlet airflow direction control device of Fig. 67 showing airflow directions at an outlet of the device;

Fig. 71 is a rear exploded perspective view of an outlet airflow direction control device according to a fifteenth embodiment of

the present invention;

Fig. 72 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 71;

Fig. 73 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 71;

Fig. 74 is a cross sectional view of the outlet airflow direction control device of Fig. 71 showing airflow directions at an outlet of the device;

Fig. 75 shows a variant of the directional-guide blade included in the fifteenth embodiment of the present invention;

Fig. 76 shows another variant of the directional-guide blade included in the fifteenth embodiment of the present invention;

Fig. 77 is a rear exploded perspective view of an outlet airflow direction control device according to a sixteenth embodiment of the present invention;

Fig. 78 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 77;

Fig. 79 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 77;

Fig. 80 is a cross sectional view of the outlet airflow direction control device of Fig. 77 showing airflow directions at an outlet of the device;

Fig. 81 is a rear exploded perspective view of an outlet airflow direction control device according to a seventeenth embodiment of the present invention;

Fig. 82 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 81;

Fig. 83 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 81;

Fig. 84 is a cross sectional view of the outlet airflow direction control device of Fig. 81 showing airflow directions at an outlet of the device;

Fig. 85 shows a variant of the directional-guide blade included in the seventeenth embodiment of the present invention;

Fig. 86 shows another variant of the directional-guide blade included in the seventeenth embodiment of the present invention;

Fig. 87 is a rear exploded perspective view of an outlet airflow direction control device according to an eighteenth embodiment of the present invention;

Fig. 88 is a front exploded and partially cutaway perspective view of the outlet airflow direction control device of Fig. 87;

Fig. 89 is a rear assembled perspective view of the outlet airflow direction control device of Fig. 87; and

Fig. 90 is a cross sectional view of the outlet airflow direction control device of Fig. 87 showing airflow directions at an outlet

of the device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please refer to Figs. 1, 2, and 3, in which an outlet airflow direction control device according to a first embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 11 and a frame 12. The frame 12 includes an inlet 122 and an outlet 123 via which an amount of fluid flows into and out of the frame 12. The fan 11 includes a hub 111 and a plurality of blades 112. The frame 12 is also internally provided with a hub seat 121 corresponding to the hub 111 of the fan 11 so as to support the fan 11 in the frame 12 by mounting the hub 111 to the hub seat 121. The hub seat 121 at the outlet 123 of the frame 12 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 14. Each of the directional-guide blades 14 is connected at an outer end, which forms a directional-guide section 141 of the directional-guide blade 14, to the frame 12, and at an inner end, which forms a connecting section 142 of the directional-guide blade 14, to the hub seat 121. It is noted the directional-guide section 141 has an area 141a larger than an area 142a of the connecting section 142. The directional-guide blades 14 are adapted to change a radial pressure against the fluid flowing through the frame 12, so that the fluid flown through the outlet 123 flows radially inward without quickly diffusing outward. Therefore, directions in which the fluid at the outlet 123 flows may be controlled and a noise produced by the fluid while flowing through the outlet 123 is reduced.

Please refer to Fig. 4. When the blades 112 of the fan 11 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 12 via the inlet 122 and out of the frame 12 via

the outlet 123. When the fluid flows through the outlet 123, it is controlled by the area 141a of the directional-guide section 141 of the directional-guide blades 14 and is subject to a relatively large radial pressure to flow toward a center behind the hub seat 121 of the frame 12. That is, there is an increased amount of the fluid flown to a rear side of the hub seat 121 to reduce a dead-air zone behind the hub seat 121. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 4, 5, and 6. The directional-guide blade 14 for the present invention may be differently configured, such as T-shaped and L-shaped blades 17, 18, as shown in Figs. 5 and 6, respectively. The T-shaped directional-guide blade 17 includes a directional-guide section 171 having an area 171a, and a connecting section 172 having an area 172a. The area 171a is larger than the area 172a. The L-shaped directional-guide blade 18 includes a directional-guide section 181 having an area 181a, and a connecting section 182 having an area 182a. The area 181a is larger than the area 182a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 123 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 7, 8, 9, and 10 that are rear exploded, front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a second embodiment of the present invention. As shown, the second embodiment is structurally and functionally similar to the first embodiment, except that the hub seat 121 at the outlet 123 of the

frame 12 of the second embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 16. Each of the ribs 16 includes an outer end forming a directional-guide section 161 having an area 161a, and an inner end forming a connecting section 162 having an area 162a. The area 161a is larger than the area 162a, so that the ribs 16 are adapted to change the radial pressure against the fluid flowing through the frame 12 and thereby achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 11, 12, and 13, in which an outlet airflow direction control device according to a third embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 21 and a frame 22. The frame 22 includes an inlet 222 and an outlet 223 via which an amount of fluid flows into and out of the frame 22. The fan 21 includes a hub 211 and a plurality of blades 212. The frame 22 is also internally provided with a hub seat 221 corresponding to the hub 211 of the fan 21 so as to support the fan 21 in the frame 22 by mounting the hub 211 to the hub seat 221. The hub seat 221 at the outlet 223 of the frame 22 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 24. Each of the directional-guide blades 24 is connected at an inner end, which forms a directional-guide section 241 of the directional-guide blade 24, to the hub seat 221, and at an outer end, which forms a connecting section 242 of the directional-guide blade 24, to the frame 22. It is noted the directional-guide section 241 has an area 241a larger than an area 242a of the connecting section 242. The directional-guide blades 24 are adapted to change a radial pressure against the fluid flowing through the frame 22 and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Fig. 14. When the blades 212 of the fan 21 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 22 via the inlet 222 and out of the frame 22 via the outlet 223. When the fluid flows through the outlet 223, it is controlled by the area 241a of the directional-guide section 241 of the directional-guide blades 24 and is subject to a relatively large radial pressure to diffuse outward into an increased space.

Please refer to Figs. 14, 15, and 16. The directional-guide blade 24 for the present invention may be differently configured, such as T-shaped and L-shaped blades 27, 28, as shown in Figs. 15 and 16, respectively. The T-shaped directional-guide blade 27 includes a directional-guide section 271 having an area 271a, and a connecting section 272 having an area 272a. The area 271a is larger than the area 272a. The L-shaped directional-guide blade 28 includes a directional-guide section 281 having an area 281a, and a connecting section 282 having an area 282a. The area 281a is larger than the area 282a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 223 to achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 17, 18, 19, and 20 that are rear exploded, front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a fourth embodiment of the present invention. As shown, the fourth embodiment is structurally and functionally similar to the third embodiment, except that the hub seat 221 at the outlet 223 of the frame 22 of the fourth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 26. Each

of the ribs 26 includes an inner end forming a directional-guide section 261 having an area 261a, and an outer end forming a connecting section 262 having an area 262a. The area 261a is larger than the area 262a, so that the ribs 26 are adapted to change the radial pressure against the fluid flowing through the frame 22 and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 21, 22, and 23, in which an outlet airflow direction control device according to a fifth embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 31 and a frame 32. The frame 32 includes an inlet 322 and an outlet 323 via which an amount of fluid flows into and out of the frame 32. The fan 31 includes a hub 311 and a plurality of blades 312. The frame 32 is also internally provided with a hub seat 321 corresponding to the hub 311 of the fan 31 so as to support the fan 31 in the frame 32 by mounting the hub 311 to the hub seat 321. The hub seat 321 at the outlet 323 of the frame 32 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 34. Each of the directional-guide blades 34 is connected at outer and inner end, which form two directional-guide sections 341 of the directional-guide blade 34, to the frame 32 and the hub seat 321, respectively. A middle portion of the directional-guide blade 34 is a connecting section 342 that connects the two directional-guide sections 341 to each other. It is noted the directional-guide section 341 has an area 341a larger than an area 342a of the connecting section 342. The directional-guide blades 34 are adapted to change a radial pressure against the fluid flowing through the frame 32, so that the fluid flown through the outlet 323 flows radially inward without quickly diffusing outward. Therefore, directions in which the fluid at the outlet 323 flows may be controlled and a noise produced by the fluid while flowing through the outlet 323 is reduced.

Please refer to Fig. 24. When the blades 312 of the fan 31 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 32 via the inlet 322 and out of the frame 32 via the outlet 323. When the fluid flows through the outlet 323, it is controlled by the areas 341a of the directional-guide sections 341 of the directional-guide blades 34 and is subject to a relatively large radial pressure to flow toward a center behind the hub seat 321 of the frame 32 and diffuse outward. That is, there is an increased amount of the fluid flown to a rear side of the hub seat 321 to reduce a dead-air zone behind the hub seat 321. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 24, 25, and 26. The directional-guide blade 34 for the present invention may be differently configured, such as H-shaped and U-shaped blades 37, 38, as shown in Figs. 25 and 26, respectively. The H-shaped directional-guide blade 37 includes two directional-guide sections 371 each having an area 371a, and a connecting section 372 having an area 372a. The area 371a is larger than the area 372a. The U-shaped directional-guide blade 38 includes two directional-guide sections 381 each having an area 381a, and a connecting section 382 having an area 382a. The area 381a is larger than the area 382a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 323 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 27, 28, 29, and 30 that are rear exploded,

front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a sixth embodiment of the present invention. As shown, the sixth embodiment is structurally and functionally similar to the fifth embodiment, except that the hub seat 321 at the outlet 323 of the frame 32 of the sixth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 36. Each of the ribs 36 includes an outer and an inner end forming two directional-guide sections 361 each having an area 361a, and a middle portion forming a connecting section 362 having an area 362a to connect the two directional-guide sections 361 to each other. The area 361a is larger than the area 362a, so that the ribs 36 are adapted to change the radial pressure against the fluid flowing through the frame 32 and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 31, 32, and 33, in which an outlet airflow direction control device according to a seventh embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 41 and a frame 42. The frame 42 includes an inlet 422 and an outlet 423 via which an amount of fluid flows into and out of the frame 42. The fan 41 includes a hub 411 and a plurality of blades 412. The frame 42 is also internally provided with a hub seat 421 corresponding to the hub 411 of the fan 41 so as to support the fan 41 in the frame 42 by mounting the hub 411 to the hub seat 421. The hub seat 421 at the inlet 422 of the frame 42 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 44. Each of the directional-guide blades 44 is connected at an outer end, which forms a directional-guide section 441 of the directional-guide blade 44, to the frame 42, and at an inner end, which forms a connecting section 442 of the directional-guide blade

44, to the hub seat 421. It is noted the directional-guide section 441 has an area 441a larger than an area 442a of the connecting section 442. The directional-guide blades 44 are adapted to change a radial pressure against the fluid flowing through the frame 42, so that the fluid flown through the outlet 423 flows radially inward without quickly diffusing outward. Therefore, directions in which the fluid at the outlet 423 flows may be controlled and a noise produced by the fluid while flowing through the outlet 423 is reduced.

Please refer to Fig. 34. When the blades 412 of the fan 41 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 42 via the inlet 422 and out of the frame 42 via the outlet 423. When the fluid flows through the inlet 422, it is controlled by the area 441a of the directional-guide section 441 of the directional-guide blades 44 and is subject to a relatively large radial pressure to flow toward a center of the hub 411. When the fluid passes through the rotating blades 412 and the outlet 423, it flows toward a center behind the hub 411 of the fan 41. That is, there is an increased amount of the fluid flown to a rear side of the hub 411 to reduce a dead-air zone behind the hub 411. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 34, 35, and 36. The directional-guide blade 44 for the present invention may be differently configured, such as T-shaped and L-shaped blades 47, 48, as shown in Figs. 35 and 36, respectively. The T-shaped directional-guide blade 47 includes a directional-guide section 471 having an area 471a, and a connecting section 472 having an area 472a. The area 471a is larger than the area 472a. The L-shaped directional-guide blade

48 includes a directional-guide section 481 having an area 481a, and a connecting section 482 having an area 482a. The area 481a is larger than the area 482a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 423 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 37, 38, 39, and 40 that are front exploded, rear exploded, front assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to an eighth embodiment of the present invention. As shown, the eighth embodiment is structurally and functionally similar to the seventh embodiment, except that the hub seat 421 at the inlet 422 of the frame 42 of the eighth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 46. Each of the ribs 46 includes an outer end forming a directional-guide section 161 having an area 661a, and an inner end forming a connecting section 462 having an area 462a. The area 461a is larger than the area 462a, so that the ribs 46 are adapted to change the radial pressure against the fluid flowing through the frame 42 and thereby achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 41, 42, and 43, in which an outlet airflow direction control device according to a ninth embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 51 and a frame 52. The frame 52 includes an inlet 522 and an outlet 523 via which an amount of fluid flows into and out of the frame 52. The fan 51 includes a hub 511 and a plurality of blades 512. The frame 52 is also internally provided with a hub seat 521 corresponding to the hub 511 of the

fan 51 so as to support the fan 51 in the frame 52 by mounting the hub 511 to the hub seat 521. The hub seat 521 at the inlet 522 of the frame 52 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 54. Each of the directional-guide blades 54 is connected at an inner end, which forms a directional-guide section 541 of the directional-guide blade 54, to the hub seat 521, and at an outer end, which forms a connecting section 542 of the directional-guide blade 54, to the frame 52. It is noted the directional-guide section 541 has an area 541a larger than an area 542a of the connecting section 542. The directional-guide blades 54 are adapted to change a radial pressure against the fluid flowing through the frame 52, and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Fig. 44. When the blades 512 of the fan 51 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 52 via the inlet 522 and out of the frame 52 via the outlet 523. When the fluid flows through the inlet 522, it is controlled by the area 541a of the directional-guide section 541 of the directional-guide blades 54 and is subject to a relatively large radial pressure to flow toward outer ends of the blades 512. When the fluid passes through the rotating blades 512 and the outlet 523, it diffuses outward into an increased space due to the relatively large radial pressure.

Please refer to Figs. 44, 45, and 46. The directional-guide blade 54 for the present invention may be differently configured, such as T-shaped and L-shaped blades 57, 58, as shown in Figs. 45 and 46, respectively. The T-shaped directional-guide blade 57 includes a directional-guide section 571 having an area 571a, and a connecting section 572 having an area 572a. The area 571a is

larger than the area 572a. The L-shaped directional-guide blade 58 includes a directional-guide section 581 having an area 581a, and a connecting section 582 having an area 582a. The area 581a is larger than the area 582a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 523 to achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 47, 48, 49, and 50 that are front exploded, rear exploded, front assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a tenth embodiment of the present invention. As shown, the tenth embodiment is structurally and functionally similar to the ninth embodiment, except that the hub seat 521 at the inlet 522 of the frame 52 of the tenth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 56. Each of the ribs 56 includes an outer end forming a directional-guide section 561 having an area 561a, and an inner end forming a connecting section 562 having an area 562a. The area 561a is larger than the area 562a, so that the ribs 56 are adapted to change the radial pressure against the fluid flowing through the frame 52 and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 51, 52, and 53, in which an outlet airflow direction control device according to an eleventh embodiment of the present invention is shown. As shown, the outlet airflow direction control device mainly includes a fan 61 and a frame 62. The frame 62 includes an inlet 622 and an outlet 623 via which an amount of fluid flows into and out of the frame 62. The fan 61 includes a hub 611 and a plurality of blades 612. The frame 62 is also internally provided with a hub seat 621 corresponding to the hub 611 of the fan 61 so as to support the fan 61 in the frame

62 by mounting the hub 611 to the hub seat 621. The hub seat 621 at the inlet 622 of the frame 62 is formed on an outer circumferential surface with a plurality of radially projected directional-guide blades 64. Each of the directional-guide blades 64 is connected at outer and inner end, which form two directional-guide sections 641 of the directional-guide blade 64, to the frame 62 and the hub seat 621, respectively. A middle portion of the directional-guide blade 64 is a connecting section 642 that connects the two directional-guide sections 641 to each other. It is noted the directional-guide section 641 has an area 641a larger than an area 642a of the connecting section 642. The directional-guide blades 64 are adapted to change a radial pressure against the fluid flowing through the frame 62 and thereby achieve the effect of controlling the direction in which the fluid at the outlet 323 flows.

Please refer to Fig. 54. When the blades 612 of the fan 61 are rotated, a non-constant flow field is produced to cause the fluid to flow into the frame 62 via the inlet 622 and out of the frame 62 via the outlet 623. When the fluid flows through the inlet 622, it is controlled by the areas 641a of the directional-guide sections 641 of the directional-guide blades 64 and is subject to a relatively large radial pressure to flow toward the hub 611 and outer ends of the blades 612. When the fluid passes through the rotating blades 612 and the outlet 623, it flows toward a center behind the hub 611 of the fan 61 and diffuse outward. That is, there is an increased amount of the fluid flown to a rear side of the hub 611 to reduce a dead-air zone behind the hub 611. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 54, 55, and 56. The directional-guide blade 64 for the present invention may be differently configured, such as H-shaped and U-shaped blades 67, 68, as shown in Figs. 55 and 56, respectively. The H-shaped directional-guide blade 67 includes two directional-guide sections 671 each having an area 671a, and a connecting section 672 having an area 672a. The area 671a is larger than the area 672a. The U-shaped directional-guide blade 68 includes two directional-guide sections 681 each having an area 681a, and a connecting section 682 having an area 682a. The area 681a is larger than the area 682a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 623 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 57, 58, 59, and 60 that are front exploded, rear exploded, front assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a twelfth embodiment of the present invention. As shown, the twelfth embodiment is structurally and functionally similar to the eleventh embodiment, except that the hub seat 621 at the inlet 622 of the frame 62 of the twelfth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 66. Each of the ribs 66 includes an outer and an inner end forming two directional-guide sections 661 each having an area 661a, and a middle portion forming a connecting section 662 having an area 662a to connect the two directional-guide sections 661 to each other. The area 661a is larger than the area 662a, so that the ribs 66 are adapted to change the radial pressure against the fluid flowing through the frame 62 and thereby achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 61, 62, and 63, in which an outlet airflow direction control device according to a thirteenth embodiment of the present invention is shown. As shown, the thirteenth embodiment includes a frame 71 and a fan module 73. The frame 71 includes an inlet 712 and an outlet 713 via which an amount of fluid flows in and out of the frame 71, respectively. The frame 71 is internally provided with a hub seat 711, on an outer peripheral wall of which a plurality of radially projected directional-guide blades 72 are formed.

The fan module 73 includes a fan frame 74 and a fan 75. The fan frame 74 includes an inlet 741 and an outlet 742, and is internally provided with a support member 743 to which the fan 75 is mounted. The fan 75 consists of a hub 751 and a plurality of blades 752. The hub 751 is supported on the support member 743 to locate the fan 75 in the fan frame 74.

Each of the directional-guide blades 72 is connected at an outer end, which forms a directional-guide section 721 of the directional-guide blade 72, to the frame 71, and at an inner end, which forms a connecting section 722 of the directional-guide blade 72, to the hub seat 711. It is noted the directional-guide section 721 has an area 721a larger than an area 722a of the connecting section 722. The frame 71 is connected at the inlet 712 to the outlet 742 of the fan module 73. The directional-guide blades 72 are adapted to change a radial pressure against the fluid flowing through the fan module 73 and the frame 71, and thereby control the flow direction of the fluid, so that the fluid flown through the outlet 713 of the frame 71 flows radially inward without quickly diffusing outward. Therefore, directions in which the fluid at the outlet 713 flows may be controlled and a noise produced by the fluid while flowing through the outlet 713 is reduced.

Please refer to Figs. 61 and 64. When the blades 752 of the fan 75 are rotated, a non-constant flow field is produced to cause the fluid to flow into the fan module 73 via the inlet 741 thereof, pass through the outlet 742 of the fan module 73 and the inlet 712 of the frame 71, and flow out of the frame 71 via the outlet 713 thereof. When the fluid flows through the frame 71, it is controlled by the areas 721a of the directional-guide sections 721 of the radially projected directional-guide blades 72 and is subject to a relatively large radial pressure to therefore flow toward a center behind the hub seat 711. That is, there is an increased amount of the fluid flown to a rear side of the hub seat 711 to reduce a dead-air zone behind the hub seat 711. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 64, 65, and 66. The directional-guide blade 72 for the present invention may be differently configured, such as T-shaped and L-shaped blades 77, 78, as shown in Figs. 65 and 66, respectively. The T-shaped directional-guide blade 77 includes a directional-guide section 771 having an area 771a, and a connecting section 772 having an area 772a. The area 771a is larger than the area 772a. The L-shaped directional-guide blade 78 includes a directional-guide section 781 having an area 781a, and a connecting section 782 having an area 782a. The area 781a is larger than the area 782a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 713 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 67, 68, 69, and 70 that are rear exploded, front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a fourteenth embodiment of the present invention. As shown, the fourteenth embodiment is structurally and functionally similar to the thirteenth embodiment, except that the hub seat 711 at the outlet 713 of the frame 71 of the fourteenth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 76. Each of the ribs 76 includes an outer end forming a directional-guide section 761 having an area 761a, and an inner end forming a connecting section 762 having an area 762a. The area 761a is larger than the area 762a, so that the ribs 76 are adapted to change the radial pressure against the fluid flowing through the frame 71 and the fan module 73 and thereby achieve the effect of controlling the flow direction of the fluid.

Alternatively, the frame 71 for the thirteenth and the fourteenth embodiment of the present invention may be otherwise connected to the inlet 741 of the fan module 73 to achieve the same functions of changing the radial pressure against the fluid and controlling the flow direction of the fluid.

Please refer to Figs. 71, 72, and 73, in which an outlet airflow direction control device according to a fifteenth embodiment of the present invention is shown. As shown, the fifteenth embodiment includes a frame 81 and a fan module 83. The frame 81 includes an inlet 812 and an outlet 813 via which an amount of fluid flows into and out or the frame 81, respectively. The frame 81 is internally provided with a hub seat 811, on an outer peripheral wall of which a plurality of radially projected directional-guide blades 82 are formed.

The fan module 83 includes a fan frame 84 and a fan 85. The fan frame 84 includes an inlet 841 and an outlet 842, and is internally provided with a support member 843 to which the fan 85 is mounted. The fan 85 consists of a hub 851 and a plurality of blades 852. The hub 851 is supported on the support member 843 to locate the fan 85 in the fan frame 84.

Each of the directional-guide blades 82 is connected at an inner end, which forms a directional-guide section 821 of the directional-guide blade 82, to the hub seat 81, and at an outer end, which forms a connecting section 822 of the directional-guide blade 82, to the frame 81. It is noted the directional-guide section 821 has an area 821a larger than an area 822a of the connecting section 822. The frame 81 is connected at the inlet 812 to the outlet 842 of the fan module 83. The directional-guide blades 82 are adapted to change a radial pressure against the fluid flowing through the fan module 83 and the frame 81.

Please refer to Figs. 71 and 74. When the blades 852 of the fan 85 are rotated, a non-constant flow field is produced to cause the fluid to flow into the fan frame 84 via the inlet 841 thereof, pass through the outlet 842 of the fan frame 84 and the inlet 812 of the frame 81, and flow out of the frame 81 via the outlet 813 thereof. When the fluid flows through the outlet 813 of the frame 81, it is controlled by the areas 821a of the directional-guide sections 821 of the radially projected directional-guide blades 82 on the frame 81 and is subject to a relatively large radial pressure to therefore diffuse outward. It is noted the fluid diffuses outward into an increased space due to the relatively large radial pressure.

Please refer to Figs. 74, 75, and 76. The directional-guide blade

82 for the present invention may be differently configured, such as T-shaped and L-shaped blades 87, 88, as shown in Figs. 75 and 76, respectively. The T-shaped directional-guide blade 87 includes a directional-guide section 871 having an area 871a, and a connecting section 872 having an area 872a. The area 871a is larger than the area 872a. The L-shaped directional-guide blade 88 includes a directional-guide section 881 having an area 881a, and a connecting section 882 having an area 882a. The area 881a is larger than the area 882a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 813 to achieve the effect of controlling the flow direction of the fluid.

Please refer to Figs. 77, 78, 79, and 80 that are rear exploded, front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to a sixteenth embodiment of the present invention. As shown, the sixteenth embodiment is structurally and functionally similar to the fifteenth embodiment, except that the hub seat 811 at the outlet 813 of the frame 81 of the sixteenth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 86. Each of the ribs 86 includes an inner end forming a directional-guide section 861 having an area 861a, and an outer end forming a connecting section 862 having an area 862a. The area 861a is larger than the area 862a, so that the ribs 86 are adapted to change the radial pressure against the fluid flowing through the frame 81 and the fan module 83 and thereby achieve the effect of controlling the flow direction of the fluid.

Alternatively, the frame 81 for the fifteenth and the sixteenth embodiment of the present invention may be otherwise connected to the inlet 841 of the fan module 83 to achieve the same functions

of changing the radial pressure against the fluid and controlling the flow direction of the fluid.

Please refer to Figs. 81, 82, and 83, in which an outlet airflow direction control device according to a seventeenth embodiment of the present invention is shown. As shown, the seventeenth embodiment includes a frame 91 and a fan module 93. The frame 91 includes an inlet 912 and an outlet 913 via which an amount of fluid flows into and out or the frame 91, respectively. The frame 91 is internally provided with a hub seat 911, on an outer peripheral wall of which a plurality of radially projected directional-guide blades 92 are formed.

The fan module 93 includes a fan frame 94 and a fan 95. The fan frame 94 includes an inlet 941 and an outlet 942, and is internally provided with a support member 943 to which the fan 95 is mounted. The fan 95 consists of a hub 951 and a plurality of blades 952. The hub 951 is supported on the support member 943 to locate the fan 95 in the fan frame 94.

Each of the directional-guide blades 92 is connected at outer and inner end, which form two directional-guide sections 921 of the directional-guide blade 92, to the frame 91 and the hub seat 911, respectively. A middle portion of the directional-guide blade 92 is a connecting section 922 that connects the two directional-guide sections 921 to each other. It is noted the directional-guide section 921 has an area 921a larger than an area 922a of the connecting section 922. The frame 91 is connected at the inlet 912 thereof to the outlet 942 of the fan module 93. The directional-guide blades 92 are adapted to change a radial pressure against the fluid flowing through the fan module 93 and the frame 91.

Please refer to Figs. 81 and 84. When the blades 952 of the fan 95 are rotated, a non-constant flow field is produced to cause the fluid to flow into the fan module 93 via the inlet 941 thereof, pass through the outlet 942 of the fan module 93 and the inlet 912 of the frame 91, and flow out of the frame 91 via the outlet 913 thereof. When the fluid flows through the outlet 913 of the frame 91, it is controlled by the areas 921a of the directional-guide sections 921 of the radially projected directional-guide blades 92 on the frame 91 and is subject to a relatively large radial pressure to therefore flow toward a center behind the hub seat 911 and also diffuse outward. That is, there is an increased amount of the fluid flown to a rear side of the hub seat 911 to reduce a dead-air zone behind the hub seat 911. Therefore, the outlet airflow direction control device of the present invention may be used to carry heat produced in a system to external environments at a largely upgraded radiation efficiency to provide an enhanced radiation effect.

Please refer to Figs. 84, 85, and 86. The directional-guide blade 92 for the present invention may be differently configured, such as H-shaped and U-shaped blades 97, 98, as shown in Figs. 85 and 86, respectively. The H-shaped directional-guide blade 97 includes two directional-guide sections 971 each having an area 971a, and a connecting section 972 having an area 972a. The area 971a is larger than the area 972a. The U-shaped directional-guide blade 98 includes two directional-guide sections 981 each having an area 981a, and a connecting section 982 having an area 982a. The area 981a is larger than the area 982a. All the above two types of directional-guide blades are adapted to change the radial pressure against the fluid passing through the outlet 913 to achieve the effect of controlling the flow direction of the fluid and producing enhanced radiating power.

Please refer to Figs. 87, 88, 89, and 90 that are rear exploded, front exploded, rear assembled, and cross sectional views, respectively, of an outlet airflow direction control device according to an eighteenth embodiment of the present invention. As shown, the eighteenth embodiment is structurally and functionally similar to the seventeenth embodiment, except that the hub seat 911 at the outlet 913 of the frame 91 of the eighteenth embodiment is formed on a peripheral wall thereof with a plurality of radially projected ribs 96. Each of the ribs 96 includes an outer and an inner end forming two directional-guide sections 961 each having an area 961a, and a middle portion forming a connecting section 962 having an area 962a to connect the two directional-guide sections 961 to each other. The area 961a is larger than the area 962a, so that the ribs 96 are adapted to change the radial pressure against the fluid flowing through the frame 91 and the fan module 93 and thereby achieve the effect of controlling the flow direction of the fluid.

Alternatively, the frame 91 for the seventeenth and the eighteenth embodiment of the present invention may be otherwise connected to the inlet 941 of the fan module 93 to achieve the same functions of changing the radial pressure against the fluid and controlling the flow direction of the fluid.

The present invention has been described with some preferred embodiments thereof and it is understood that many changes and modifications in the described embodiments can be carried out without departing from the scope and the spirit of the invention as defined by the appended claims.